Problem Solving using Eqns for Unif. Acc. Motion

#1 ⊕ → W

$\vec{v}_1 = 20\,m/s$
$\vec{v}_2 = 0\,m/s$
$\Delta t = 10\,s$
$\Delta \vec{d} = ?$
$\vec{a}$ ~~$\vec{a}$~~

$\Delta \vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2} \Delta t$

$= \frac{(0+20)}{2} 10$

$= 10 \cdot 10$

$= 100\,m$

#2 ⊕ → W

$\vec{v}_1 = 16\,m/s$
$\vec{v}_2 = 4\,m/s$
$\Delta t = 5.0\,s$
$\Delta \vec{d} = ?$
$\vec{a}$ ~~$\vec{a}$~~

$\Delta \vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2} \Delta t$

$= \frac{(16+4)}{2} (5)$

$= 10\,(5)$

$= 50\,m$

#3 ⊕ → up

$\vec{v}_1 = 5.0\,m/s$
$\Delta t = 4.0\,s$
$\vec{v}_2 = -10\,m/s$ (-ve because it's moving down)
$\Delta \vec{d} = ?$
$\vec{a}$ ~~$\vec{a}$~~

$\Delta \vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2} \Delta t$

$= \frac{(5-10)}{2} (4)$

$= -10\,m$

#4 (does this is #5) ⊕ → [N45°W]

$\vec{v}_1 = 3\,m/s$
$\vec{a} = 4.0\,m/s^2$
$\vec{v}_2 = 33\,m/s$
$\Delta t = ?$
$\Delta \vec{d}$ ~~$\Delta \vec{d}$~~

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$33 = 3 + 4\Delta t$
$30 = 4\Delta t$
$\Delta t = 7.5\,s$

#5 ⊕ → E

$\vec{v}_1 = 10\,m/s$
$\vec{a} = 5.0\,m/s^2$
$\vec{v}_2 = 25\,m/s$
$\Delta t = ?$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$25 = 10 + 5\Delta t$
$\Delta t = 3.0\,s$

u — 4 — a —

#6 ⊕ ↑ N

$\Delta \vec{d}$
$\vec{v}_1 = 18\,km/h \xrightarrow{\div 3.6} 5\,m/s$
$\vec{a} = 1.5\,m/s^2$
$\Delta t = ?$
$\vec{v}_2 = 72\,km/h \xrightarrow{\div 3.6} 20\,m/s$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$
$20 = 5 + 1.5\Delta t$
$\Delta t = 10\,s$

— 4 — a — u — 4

#7 ⊕ → up

$\vec{v}_1 = 25\,m/s$
$\vec{a} = -5\,m/s^2$
$\Delta t = 15\,s$
$\Delta d = ?$
½

$\Delta \vec{d} = \vec{v}_1 \Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$= (25)(15) + \frac{1}{2}(-5)(15)^2$

$= 375 - 562.5$

$= -187.5\,m$

#8 ⊕ down →

$\vec{v}_1 = 2.0\,m/s$

$\vec{a} = 3.0\,m/s^2$

$\Delta\vec{d} = ?$

$\Delta t = 6.0\,s$

$\vec{v}_2$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$= 2(6) + \frac{1}{2}(3)(6)^2$

$= 66\,m$

#9 ⊕ up →

$\vec{v}_1 = 100\,km/h \rightarrow 27.78\,m/s$

$\vec{v}_2$

$\vec{a} = -0.40\,m/s^2$

$\Delta t = 60\,s$

$\Delta\vec{d} = ?$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}a\Delta t^2$

$= 27.78(60) + \frac{1}{2}(-0.40)(60)^2$

$= 1666.8 - 720$

$= 946.8\,m$

#10 $\vec{v}_1 = 0\,m/s$ ⊕ S →

$\vec{v}_2 = 26\,m/s$

$\Delta t = 6.0\,s$

(a) $\vec{a} = ?$

$\vec{v}_2 = \vec{v}_1 + \vec{a}\Delta t$

$26 = 0 + 6\vec{a}$

$\vec{a} = 4.3\,m/s^2$

(b)

$\Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$

$= \frac{(0+26)}{2}(6)$

$= 78\,m$

AVG. VEL. = TOTAL DISPLACEMENT / TIME

$= 78/6$

$= 13\,m/s$

#11 ⊕ down →

$\vec{a} = 3.0\,m/s^2$

$\Delta t = 6.0\,s$

$\Delta\vec{d} = 78\,m$

$\vec{v}_1 = ?$

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$78 = 6\vec{v}_1 + \frac{1}{2}(3)(6)^2$

$78 = 6\vec{v}_1 + 54$

$6\vec{v}_1 = 24$

$\vec{v}_1 = 4\,m/s$

$\vec{v}_2 = ?$

$\Delta\vec{d} = \vec{v}_2\Delta t - \frac{1}{2}\vec{a}\Delta t^2$

$78 = 6\vec{v}_2 - \frac{1}{2}(3)(6)^2$

$78 = 6\vec{v}_2 - 54$

$6\vec{v}_2 = +102$

$\vec{v}_2 = 17\,m/s$

#12 ⊕ Fwd →

$\Delta\vec{d} = 28\,m$

$\Delta t = 22\,s$

$\vec{v}_1 = ?$

$\vec{v}_2 = 0\,m/s$

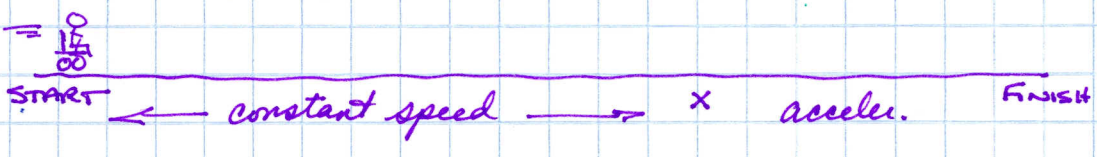
$\Delta\vec{d} = \frac{(\vec{v}_1 + \vec{v}_2)}{2}\Delta t$

$28 = \frac{(\vec{v}_1 + 0)}{2}(22)$

$28 = 11\,\vec{v}_1$

$\vec{v}_1 = 2.55\,m/s$

#13 ⊕ FWD



Stage 1

$\Delta\vec{d} = 1500 - 240$
$= 1260\,m$
$\Delta t = 3.5\,min$
$= 210\,s$
$\therefore \vec{v} = 6\,m/s$

$\vec{a} = ?$
$\Delta t = 3\,min\ 59.9\,s - 3\,min\ 30\,s$
$= 29.9\,s$
$\Delta\vec{d} = 240\,m$
$\vec{v}_1 = ?$ can get this from Stage 1
~~$\vec{v}_2$~~

$\Delta\vec{d} = \vec{v}_1\Delta t + \frac{1}{2}\vec{a}\Delta t^2$

$240 = 6(29.9) + \frac{1}{2}\vec{a}(29.9)^2$

$a = 0.136\,m/s^2$

#14 ⊕ FWD

$\vec{v}_1 = 100\,km/h \xrightarrow{\div 3.6} 27.78\,m/s$
$\vec{v}_2 = 0\,m/s$

$\Delta\vec{d} = 45\,m$
$\vec{a} = ?$

$\vec{v}_2^{\,2} = \vec{v}_1^{\,2} + 2\vec{a}\Delta d$
$0 = 27.78^2 + 90\vec{a}$
$\vec{a} = -8.57\,m/s^2$

#15 $\Delta\vec{d}_1 = 40\text{m}\,[\text{S}]$

$\Delta\vec{d}_2 = 50\text{m}\,[\text{W}]$

$\Delta\vec{d}_3 = 30\text{m}\,[\text{W}\,30°\,\text{E}]$

$\Delta t = 4.25\text{min} = 255\text{s}$

$\vec{v}_{avg} = \dfrac{\text{total displacement}}{\text{total time}}$

$\vec{v}_{avg} = \dfrac{\Delta\vec{d}}{\Delta t}$

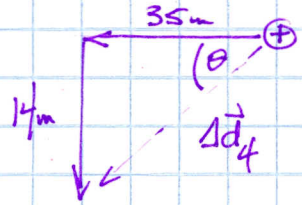
$= \dfrac{37.7\,[\text{W}\,21.8°\,\text{S}]}{255}$

$= 0.148\text{m/s}\,[\text{W}\,21.8°\,\text{S}]$

To find total displacement.

HORIZ $\oplus \xrightarrow{E}$ VERT $\uparrow_{N}\ \oplus$

$\Delta\vec{d}_{1x} = 0\text{ m}$	$\Delta\vec{d}_{1y} = -40\text{m}$
$\Delta\vec{d}_{2x} = -50\text{m}$	$\Delta\vec{d}_{2y} = 0\text{ m}$
$\Delta\vec{d}_{3x} = 30\sin 30\text{ m/s}$	$\Delta\vec{d}_{3y} = 30\cos 30\text{ m/s}$
$\Delta\vec{d}_{4x} = -35\text{m}$	$\Delta\vec{d}_{4y} = -14.0\text{m}$



$|\Delta\vec{d}_4| = \sqrt{35^2 + 14^2}$

$= 37.70\text{ m}$

$\theta = \tan^{-1}\left(\frac{14}{35}\right)$

$= 21.8°$

$\Delta\vec{d}_4 = 37.70\text{ m}\,[\text{W}\,21.8°\,\text{S}]$